Maths complements for Computational Mechanics a ATENEA Labs

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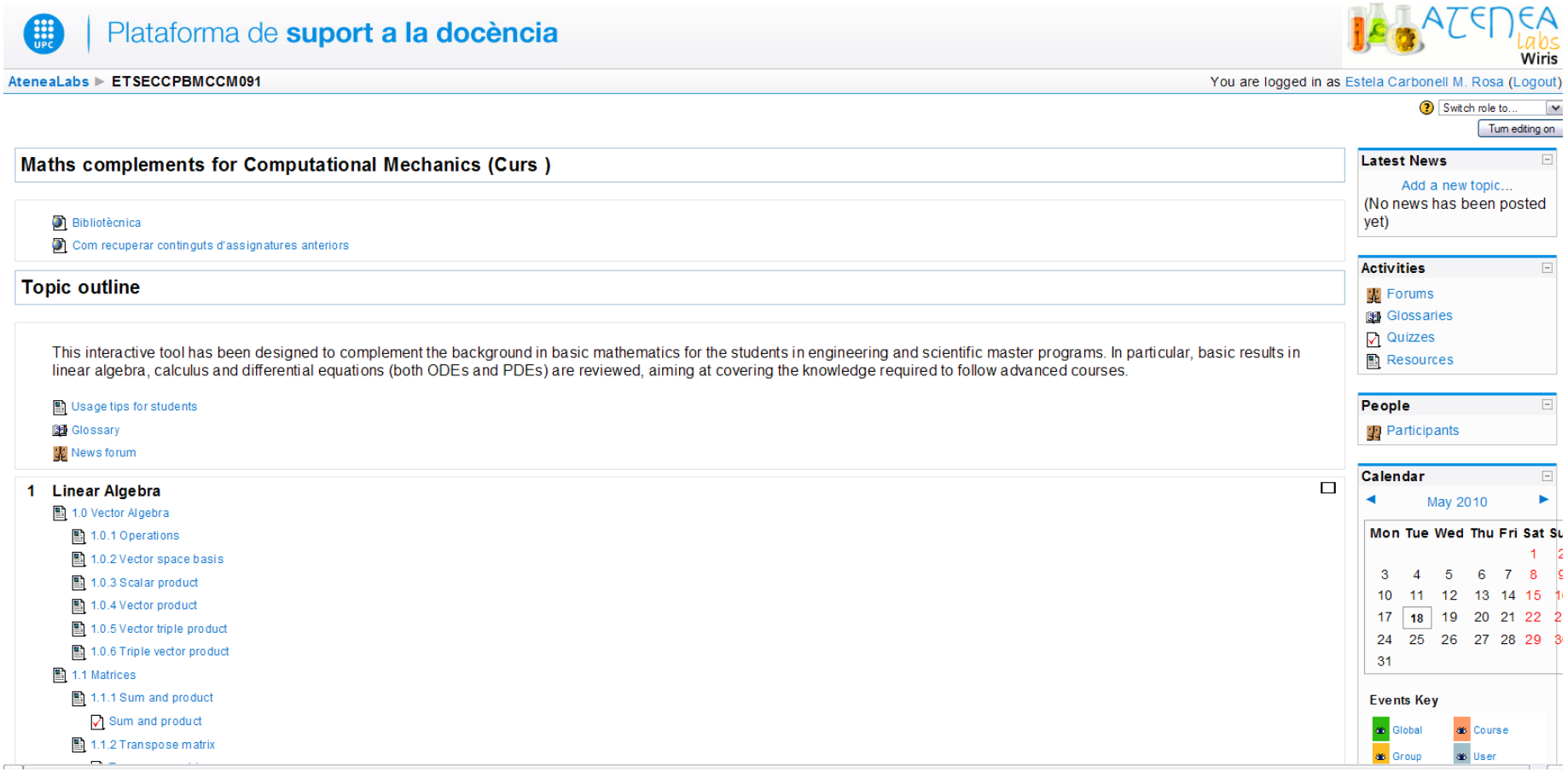
- Resum: Els estudiants que ingressen als màsters en anglès de la UPC provinents d'altres països sovint tenen carències en coneixements bàsics de matemàtiques que s'imparteixen al primer cicle (Bachelor). El nostre projecte consisteix en la creació d'un curs a Moodle en anglès, a on poden trobar aquest conceptes requerits a les assignatures de màster. En aquest curs a més de la teoria i exemples, hi ha exercicis interactius que faciliten l'autoaprenentatge, així com diferents test d'autoavaluació utilitzant WirisQuizzes.

- Paraules clau: Maths, Màster, Moodle, WIRIS

Curs a Moodle



Estructura del curs. Teoria

3.1.2 Initial and boundary conditions

Property

The general solution of an ODE is the most general function $y(x)$ that satisfies the equation; it will contain constants of integ
initial or boundary condition condition.

Definition (Initial problem).

Find the funtion y, satisying

$$\begin{cases} F(x;y(x),y'(x),\ldots,y^{(n)}(x))=0 & \text{for } a<x\leq b, \\ y(a)=y_0, \end{cases}.$$

Definition (Dirichlet boundary problem).

Find the funtion y, satisying

$$\begin{cases} F(x;y(x),y'(x),\ldots,y^{(n)}(x))=0 & \text{for } a<x<b, \\ y(a)=y_0, \\ y(b)=y_1, \end{cases}.$$

Definition (Neumann boundary problem).

Exemples. Problemes resolts

3. Some roots are repeated: if λ_1 is repeated k times, then

$$y_c(x) = (c_1 + c_2 x + \cdots + c_k x^{k-}$$

Example 3.2.2.

Property

Finding the parti
function for $y_p(x)$
Standard trial fur

1. If $f(x) = ae^{rx}$,
2. If $f(x) = a_1 \sin$
3. If $f(x) = a_0 + a$
4. If $f(x)$ is the

Example 3.2.2.

Example 3.2.2.

Given the equation

$$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = e^x,$$

let us find its complementary function. Considering the equation homogeneous, substituting $y = Ae^{\lambda x}$ and dividing through by $Ae^{\lambda x}$, we obtain the auxiliary equation

$$\lambda^2 - 2\lambda + 1 = 0.$$

The root $\lambda = 1$ occurs twice, therefore

$$y_c(x) = (c_1 + c_2 x)e^x.$$

Example 3.2.3.

Example 3.3.1.

Example 3.3.1.

The elastic beam: we consider a model for a horitzontal clamped beam (placed as in figure 3.1) made of an elastic material subject to a v the beam satisfies

$$\begin{cases} \frac{1}{EI}u^{(4)}(x) = f(x) & \text{for } 0 < x < 1, \\ u(0) = u'(0) = u(1) = u'(1) = 0. \end{cases}$$

being E Young's Modulus and I is the section second moment of area.

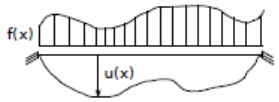


Figure 3.1: Elastic beam scheme

Example 4.4.2.

In the special case of heat propagation in an isotropic and homogeneous medium in a 3-dimensional space, this equation is

$$\kappa\left(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}+\frac{\partial^2 u}{\partial z^2}\right)=\frac{\partial u}{\partial t}$$

where

- $u=u(t,x,y,z)$ is temperature as a function of time and space
- $\frac{\partial u}{\partial t}$ is the rate of change of temperature at a point over time
- u_{xx}, u_{yy} and u_{zz} are the second spatial derivatives (thermal conductions) of temperature in the x, y, and z directions, respectively
- κ is now the thermal diffusivity, a material-specific quantity depending on the thermal conductivity, the density and the heat capacit

You can visualize it with this animation:

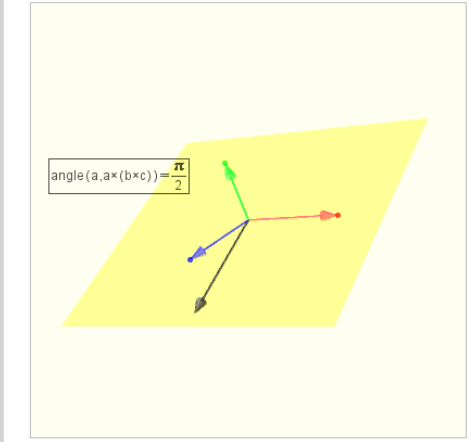
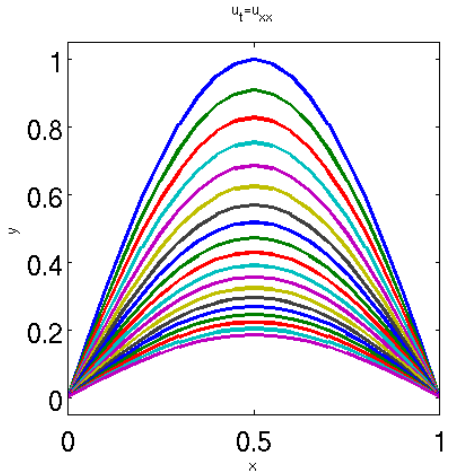


Figure 1.3: Triple vector product



Tests interactius d'autoavaluació

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1

Marks: 0/1

Solve this separate-variable ordinary differential equation.

$$\frac{dy}{dx} = (x^2 - 1) \cdot y(x) + (x^2 - 1)$$

Type only the function definition (if y(x)=sin(x), type sin(x))

Answer

Edit

General | Operators | Symbols | Big Ops. | Matrix | Arrows | Greek | Script and accent | Other

sin(x)

Submit

Incorrect

Marks for this submission: 0/1. This submission attracted a penalty of 0.1.

Save without submitting | Submit page | Submit all and finish

Page: 1 2 3 4 5 (Next)

Agraïm la col·laboració de Alba Pros Parés i de l'empresa Maths for More
així com els ajuts rebuts a diferents convocatòries de la UPC-BarcelonaTech
i de l'Escola Tècnica Superior d'Enginyers de Camins, Canals i Ports de Barcelona.